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(54) **PACKET DATA TRANSFERRRING METHOD FOR MOBILE RADIO DATA COMMUNICATION SYSTEM**

(57) In order top transfer packet datata to an M-DTE (14) on a mobile radio station side from n a DTE (22) on a company LAN system side without usising any troublesome means in a communication syststem including a premise PC system (10) and a compaɾany LAN system (20), a LAN-side controller (23) sendɨds a connection request containing the packet address:s of packet data addressed to the M-DTE (14) to the PBXʲX (11) of the system (10) when the controller (23) receɨeives the packet data, the PBX (11) informs a PS (13) of tɨ the arrival at the packet address through a CS (12), and the M-DE (14) connected to the PS (13) makes a response to the arrival through the PS (13) and CS (12) when the informed packet address corresponds to the M-DTE (14), thus the PBX (11) connecting the M-DTE (14) to the controller (23). When the M-DTE (14) is connected to the controller (23), the controller (23) transfers the packet data (13) to the M-DTE (14).

FIG. 1

EP 0 828 398 A1
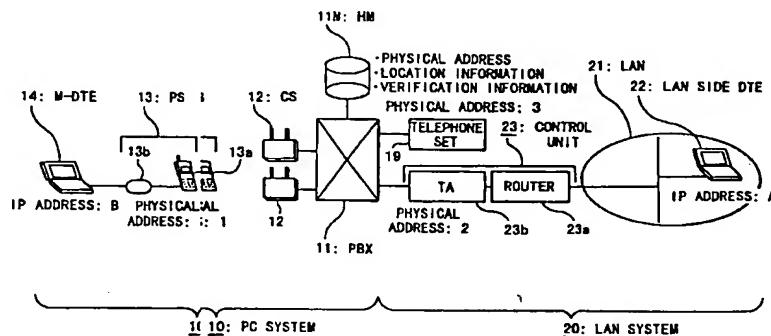
Description

Technical Field

This invention relates to a method of ¡f packet data transmission in a mobile radio data commururnication system which can be used in a virtual netwo/ork across a mobile communications network and a LAN.N.

Technical Background

Recently, personal communications tecechnology as an extension of development of a cordless:ss telephone technology has been progressed. And ¡ attention is focused on a wireless PBX (Private Branchch eXchange) system which was developed based on ththis personal communication technology.

With respect to this wireless PBX sysystem, as a result of further search and development of of the mobility along with the development of wireless tetechnology of telephone sets, it cam to be apparent that tt the wireless PBX system can be used not only in a s service area under the control of a single wireless PBX;X system but also with respect to a movable area betwereen PBXs by means of automatic registration of a currennt location of a given end system without a need of compipelling a user or subscriber to make a meaningless chanange of registration (or activation of transmission of an inincoming signal or the like).

On the other hand, there is currently aran increasing need of a data communication through tl the Internet. There are two types of data communicatidion methods; the first one is a method by way of a telephcnone line (line switch) and the second one is a method foror performing a communication from a terminal device:e accommodated in a LAN. The method of using a LA_AN is mostly employed in the in-enterprise communicatidion.

In this in-enterprise communication, it it sometimes becomes necessary to use a system which in is capable of performing a packet data communication acicross various physical networks as represented by a L/LAN such as Ethernet, etc. In order to perform a routining of packet data between end terminal devices across;s the various physical networks, it is required that ea:ach terminal device can uniquely be identified. To this erend, each terminal device is assigned for use with ¡ an address (packet address) on a virtual network as repapresented by an IP (Internet Protocol) address, etc.

Hereinbefore, the Internet, which is bəbased on the wireless PBX system where a data commmmunication is performed chiefly by way of line switching ar and the LAN, has been described. The former is comirqng to be well accepted as a main communication meaians in many offices by applying mobility thereto, while ə the latter is becoming a main communication means fofor data communication.

Incidentally, a new data communicatioioon system is currently being searched and developed. I. In this new system, a wireless PBX system and a LAN are coupled and a data communication terminal device is connected to a personal station located in the wireless PBX system so that a data communication can be performed between this data communication terminal device and a data communication terminal device on the LAN side.

In the above case, in order to transmit packet data to the data communication terminal device under the control of the wireless PBX system from the LAN side, it is necessary for the LAN side to identify an IP address of that data communication terminal device because the data communication terminal device under the control of the wireless PBX system is one of the network terminal devices having a series of different physical addresses.

In order to deliver the above packet data to the particular data communication terminal device through the wireless PBX system, it is necessary that the wireless PBX system side identifies a physical address of the particular data communication terminal device, i.e., physical address of a personal station to which the specific data communication terminal device is connected, while referring to the IP address and that the wireless PBX system forms a physical link between the personal station and the LAN.

In order to form such a physical link, the IP address must primarily be determined from the IP address. To this end, there are required such complicated procedures that a connective relationship between each data communication terminal device and each personal station is fixed, or a means for obtaining a corresponding relationship between each data communication terminal device and each personal station is provided within the system, and so forth.

Disclosure of Invention

The present invention has been accomplished in view of the above situation. It is, therefore, an object of the present invention to provide a method of packet data transmission in a mobile radio data communication system, in which packet data can be transmitted from a LAN side to a given data communication terminal device on a personal station side without a need of such complicated procedures as mentioned above.

To achieve the above object, according to the present invention, there is provided a method of packet data transmission in a mobile radio data communication system comprising a personal station, a mobile data terminal equipment to be connected to the personal station, a wireless connection equipment for performing a wireless connection with the personal station, an exchange for connecting the personal station and a counterpart thereof through the wireless connection equipment, a LAN, a data terminal equipment on the LAN side connected to the LAN, and a control unit for performing a transmission control of packet data in the LAN and a transmission control of packet data between

the exchange and the LAN, characterized in that the mobile data terminal equipment is aassigned with a packet address to be used in the LAN, I, and the control unit is preliminarily stored therein a packcket address corresponding to the mobile data termininal equipment; when transmitting packet data to the monobile data terminal equipment, the LAN side data termminal equipment transmits packet data including a packetet address of the mobile data terminal equipment to the LAN; if the packet address included in the packet data rereceived through the LAN is the packet address of the monobile data terminal equipment, the control unit reserves s the packet data and requests the exchange to connecect to the packet address; when requested a connectioron to the packet address, the exchange establishes a a communication path for the control unit and transmits a a signal including the packet address to the personal statation through the wireless connection equipment; if the p packet address included in the signal is a packet addressss corresponding to the mobile data terminal equipment, tr the personal station transmits an acknowledgment signanal; when receiving the acknowledgment signal througugh the wireless connection equipment, the exchange aclcknowledges the connection to the packet address to the e control unit; and when receiving the acknowledgmenent from the exchange, the control unit transmits the re reserved packet data to the mobile data terminal equipmment.

From another aspect of the inventidion, there is also provided a method of packet data trararansmission in a mobile radio data communication systeiem comprising a personal station, a mobile data terminanal equipment to be connected to the personal station, i a wireless connection equipment for performing a wireteless connection with the personal station, an exchangeje for connecting the personal station and a counterpart it thereof through the wireless connection equipment, a L LAN, a data terminal equipment on the LAN side connerected to the LAN, and a control unit for performing a transismission control of packet data in the LAN and a transmimission control of packet data between the exchange andid the LAN, characterized in that the mobile data termininal equipment is assigned with a packet address to be usused in the LAN, and the control unit is preliminarily ststored therein a packet address corresponding to the monobile data terminal equipment; when transmitting packcket data to the mobile data terminal equipment, the LAIAN side data terminal equipment transmits packet dadata including a packet address of the mobile data terrrminal equipment to the LAN; if the packet address includeded in the packet data received through the LAN is the pajacket address of the mobile data terminal equipment, t the control unit reserves the packet data and requests ti the exchange to notify of the incoming signal to the p packet address; when requested a notice of an incomining signal to the packet address, the exchange and trararansmits a signal including the packet address to the p personal station through the wireless connection equiuipment without establishing a communication path for ththe control unit; if

the packet address included in the signal is a packet address corresponding to the mobile data terminal equipment, the personal station transmits a call signal to the control unit; the exchange transmits an incoming signal to the control unit in response to the call signal through the wireless connection equipment; when receiving the incoming signal, the control unit transmits an acknowledgment signal to the exchange; when receiving the acknowledgment, the exchange establishes a communication path between the control unit and the personal station; and the control unit transmits the reserved packet data to the mobile data terminal equipment through the communication path.

With a method of packet data transmission in a mobile radio data communication system thus constructed in accordance with the present invention, there can be exhibited such effects that packet data can be transmitted from a data communication terminal device on the LAN side to a data communication terminal device on the personal station side without a need of fixing a connective relationship between each data communication terminal device and each personal station on a virtual network across a wireless network system of the type of line switching and the LAN and without a need of pursuing complicated procedures for providing a means for obtaining a corresponding relationship between an IP address and a physical address of the respective data communication terminal devices.

Brief Description of Drawings

Fig. 1 is a diagram showing a configuration of an in-enterprise mobile radio data communication system applicable to the present invention.

Fig. 2 is a diagram for explaining an address management in the above communication system.

Fig. 3 is a connection sequence diagram showing an operation of a mobile radio data communication system according to the first embodiment of the present invention.

Fig. 4 is a connection sequence diagram showing an operation of a mobile radio data communication system according to the second embodiment of the present invention.

Fig. 5 is a connection sequence diagram showing an operation of a mobile radio data communication system according to the third embodiment of the present invention.

Fig. 6 is a connection sequence diagram showing an operation of a mobile radio data communication system according to the fourth embodiment of the present invention.

Fig. 7 is a connection sequence diagram showing an operation of a mobile radio data communication system according to the fifth embodiment of the present invention.

Fig. 8 is a diagram showing another example of a configuration of an in-company mobile radio data com-

munication system applicable to the present invention.

Fig. 9 is a block diagram showing function models of a personal station and a mobile data communication terminal device of Fig. 8.

Fig. 10 is a connection sequence diagrgram showing an operation of a mobile radio data communication system according to the sixth embodiment of of the present invention.

Best Mode for Carrying Out the Invention

(Communication System to Which the Invention is Applied)

Fig. 1 shows a configuration of an in-enterprise mobile radio data communication system asas one example to which the present invention can be a applied. This in-enterprise mobile data communication s system comprises a combination of an in-office personanal communication (PC) system 10 and an in-enterprise e LAN system 20. This system usually performs a data communication using a TCP/IP (Transmission Control Prototocol/Internet Protocol) as a communication protocol.

The in-office PC system 10 comprises es a private branch exchange (hereinafter simply refeferred to as "PBX") 11, cell stations (hereinafter simplyly referred to as "CS") 12, and a personal station (hereininafter simply referred to as "PS") 13.

Here, the PBX 11 includes a control ururnit, a switching unit and a base band processing unit in n addition to a home memory (HM) 11M for storing thereiein a physical address, location information, verification n information, etc., of the PS 13 which is under the controlol of the PBX 11. By means of activity of those various elelements, the PBX 11 controls the overall in-office PC C system 10, switches the line for the information flowingng on a communication channel, encoding voices, charanges a communication channel, verifies the PS, managiges a current location and so forth. Reference numeral 1919 denotes an ordinary telephone set connected to the PB'BX 11.

Each CS (two are shown in Fig. 1) 1212 includes a radio unit (modulation/demodulation unit), a a control unit, and an interface unit with respect to the l PBX 11. By means of activity of those various elements, s, each CS 12 undertakes a task for connection between ti the PS 13 in a wireless manner and for connection betweveen the PBX 11 through a wire interface. Each CS 12 hasas a role as a relay means for a control signal and a i information between the PS 13 and the PBX 11.

The PS 13 comprises a radio ururnit (modulation/demodulation unit), a base band proccessing unit, an external terminal interface unit, and the e like. The PS 13 performs a sending and receiving functicition of signal for a voice and a data communication, a an encoding function of voice, and so forth. Among sisuch PS 13, there exists one, as shown in Fig. 1, to whihich a mobile data terminal equipment (hereinafter simplyly referred to as "M-DTE") 14 having a serial interfacace as such

RS232C is connected. As the PS 13, an mobile device body 13a having an adapter 13b connected thereto is employed. The PS 13 is connected at the adapter 13b to the M-DTE 14 through a serial interface. The adapter 13b employed here includes a protocol conversion unit and an interface unit. The adapter 13b performs a terminating function of the protocol. It should be noted that although the M-DTE, adapter and PS are separated in logical function, they are not necessarily physically separate bodies as shown but may be of an integral body.

On the other hand, the in-enterprise LAN system 20 comprises a LAN 21 using a physical medium such as Ethernet, for example. Connected to the in-enterprise LAN system 20 through an Ethernet board are a plurality of LAN side data terminal equipment devices (hereinafter simply referred to as DTE). It should be noted that the LAN 21 may be other physical medium than the Ethernet.

The LAN 21 is divided into a plurality of sub-networks. Each sub-network is connected to the PBX 11 of an in-office PC system 10 through a controller 23 which comprises a router 23a and a terminal adapter (hereinafter simply referred to as "TA") 23b.

The router 23a performs a routing function of packet data between the particular sub-network and other sub-network, and between the particular sub-network and the in-office PC system 10. The TA 23b comprises a protocol conversion unit, and an interface unit. The TA 23b is connected to the PBX 11 through an ISDN or a private interface. The TA 23b undertakes a task for performing a sending and receiving function of signal, terminating function of protocol, and so forth.

(2: Connection Procedure of Communication System)

Next, a connection procedure to be performed in the in-enterprise communication system when packet data are transmitted, will be described.

(2-1: In Case Packet Data are Transmitted from PS 13 to Other PS 13)

First, a connection procedure to be performed in this communication system when packet data are transmitted from the PS 13 to other PS 13, is described.

The connection procedure is performed in accordance with the following sequential steps.

(1) The PS 13 on the sender side requests the CS 12 to establish a radio channel.
(2) The CS 12 establishes a radio channel between the PS 13 on the sender side.
(3) The PS 13 one the sender side designates a physical address (extension number) of the PS 13 on the receiver side.
(4) The PBX 11 sends an incoming signal to the CS 12, designating a call number (this being occasionally the same as the extension number) of the PS

13 on the sender side based o,on the physical address.

(5) The CS 12 performs a notifyingng function of an incoming signal by the call numberer designated by the incoming signal.

(6) The PS 13 on the receiver side r; requests the CS 12 to establish a radio channel :l when the call number, by which the incoming sigrgnal is notified, is in agreement with a call number wwhich the PS 13 itself has.

(7) The CS 12 establishes a radio clchannel between the PS 13 on the receiver side in a accordance with this request.

(8) The PS 13 on the receiver sidele notifies the CS 12 of an incoming signal acknowledxdgment.

(9) The PBX 11 establishes a commmunication path between the PS 13 on the receiver :r side.

(2-2: In Case Packet Data are Transmittitted Between One Pair of M-DTEs, or Between M-DTfTE and DTE)

Next, a connection procedure to b be performed in this communication system when packetet data are transmitted from the PS 13 to other PS 13, isis described. The problem of conformity of address managigement between networks which constitute the in-enterprorise communication system is brought up. Fig. 2 is a didiagram in which the in-enterprise communication systemm is divided from this view point of address management.rt.

As shown in this Figure, in the in-e-enterprise communication system, there are an area $\underline{A}\underline{A}$ where a physical address (telephone number) by the b PBX 11 is used (i.e., part excluding M-DTE of the in-ofbffice PC system 10), and an area B where a physical adiddress (Ethernet address) by the LAN is used (i.e., in-n-enterprise LAN system 20). In order to make it possibfible to perform a data communication across the areasas $\underline{A}$ and B, IP addresses with an ensured uniqueness s are assigned to the M-DTE and DTE within the systemm over the entire area of the system including those areasas.

In order to perform a routing funcnction between a pair of data communication terminal eququipment devices which belong to areas having a differenant address management, a connection procedure in theche IP layer and a connection procedure in the physical layıyer are both necessary. For this reason, it becomes neıecessary that an address (IP address) to be used in theıe IP layer and a physical address (Ethernet in the in-enteterprise LAN system 20, and an extension number in tl the in-office PC system 10) are in mutually correspondiriing relation.

Here, the in-enterprise LAN systemm 20 is of a connectionless type network, in which a nonode (in general, router) for relaying the IP packet ciconverts the IP address and the Ethernet address and p̣ performs a relay transmission of the IP packet. Therefofore, there is no problem in address management with rerespect to routing in the LAN 21.

On the other hand, the in-business ß PC system 10 is of a connection type network, in which an end-to-end physical link is established through the PBX 11 and a communication is performed by line switching. Therefore, for performing a routing between the M-DTE and the DTE or between the M-DTE and other M-DTE, a communication counterpart (DTE or other M-DTE) of the particular M-DTE is identified by the IP address. However, because there is located the in-office PC system 10 on the communication route to the communication counterpart, it is absolutely necessary to establish a physical link within the system.

In case packet data are transmitted, for example, from the M-DTE 14 of Fig. 1 to the DTE 22 (IP address: $\underline{A}$) in the LAN 21, it is good enough that a physical link for connecting the particular M-DTE 14 to the control unit 23 is established within the in-office PC system 10 and therefore, a routing can be performed by way of a simple procedure. The procedure is as follows.

First, the M-DTE 14 requests the PS 13 to transmit a signal to the TA 23a of the control unit 23. Upon receipt of this request, the PS 13 identifies a physical address (= 2) of the TA 23b and sends a connection request to the PBX11 through the CS 12. As a consequence, a physical link for connecting the PC 13 and the TA 23b together is established by the PBX 11.

Then, through the physical link thus established, an IP address (= $\underline{A}$) of the DTE 22 is transmitted from the M-DTE 14 to the router 23a of the control unit 23. Thereafter, packet data are transmitted from the M-DTE 14 to the DTE 22 utilizing the relay transmission of the IC packet by way of the router.

On the contrary, an attempt for transmitting packet data from the DTE 22 to the M-DTE will encounter the following problems.

Specifically, the DTE 22 requests a connection with the M-DTE 14, specifying an IP address (= B) of the M-DTE 14. In order to fulfill the request for connection, it is necessary to establish a physical link from the router 23a to the physical address (i.e., PS 13 to which the M-DTE 14 is connected) of the M-DTE 14. In order to establish this physical link, it is necessary to obtain a physical address (= 1) from the IP address (= B) of the M-DTE 14.

In order to primarily convert the IP address to the physical address, it is necessary that the M-DTE 14 within the in-office PC system are all connected to the particular PS 13 to fix the connective relation. However, if the connective relation between the M-DTE and the PS is fixed as mentioned, the system badly lacks flexibility. On the other hand, if such a connective relation is not fixed, it becomes necessary to provide a very complicated means within the system, such as means for securing a corresponding relationship between the IP address of each data communication terminal equipment and the physical address.

The present invention makes it possible to provide a routing for transmitting packet data from the DTE to the M-DTE without a need of compelling a fixed connec-

tive relation between the M-DTE and the PS'S and a management of corresponding relationship betwtween the IP address and the physical address.

Specific embodiments thereof willvill now be described hereinafter.

(3: First Embodiment)

Fig. 3 is a diagram showing a connecticion sequence when packet data are transmitted from thene DTE to M-DTE in a mobile radio data communicatation system according to the first embodiment of the proresent invention.

First, in this embodiment, the control ununit includes a memory unit for storing therein IP addresseses.

All IP addresses of the M-DTE connececated through the control unit in the in-office PC system a are stored in this memory unit.

When transmitting packet data to a M-D DTE of the in-office PC system, the DTE in the LAN transmsmits packet data including the IP address of the M-D DTE into the LAN.

The packet data thus transmitted are a received by the control unit in the LAN. At that time, thene control unit judges whether or not the IP address inclicluded in the received packet data is coincident with orone of the IP addresses of the M-DTE stored in the memmory unit.

As a result of the judgment, if the i received IP address is determined as the IP address of of the M-DTE, the control unit reserves the received packcket data and sends a connection request to the PBX in n the in-office PC system. This connection request includdes information indicating a fact that there is an incomiining signal to the IP address of the M-DTE, and the p particular IP address.

When receiving this connection requeiest, the PBX sends an incoming signal notice message t to all the CS which controls a call area of the particular ir IP address. This incoming signal notice message alalso includes information indicating a fact that there is ε an incoming signal to the IP address of the M-DTE, and id the particular IP address.

The incoming signal notice message t thus sent is transmitted to each PS in a radio section n of each CS through the CS. When receiving the incocoming signal notice message, each PS analyzes the cocontent of the message. Here, because the incoming sisignal notice message received from the CS includes theie information indicating a fact that there is an incoming sigignal to the IP address of the M-DTE, the PS detects anın IP address from the incoming signal notice message arand transmits an incoming signal potifying signal incluouding this IP address to the M-DTE through an adapter. A At the time of transmission, the adapter performs a prototocol conversion between the PS and the M-DTE.

When receiving the incoming signal n notifying signal, the M-DTE compares the IP address is included in this incoming signal notifying signal with arın IP address

assigned to the particular M-DTE. As a result of the comparison, if both the IP addresses are not in coincident with each other, the M-DTE makes no response at all. On the other hand, if both the IP addresses are in coincident with each other, the M-DTE recognizes a fact that there is an incoming signal to the particular M-DTE, and sends an incoming signal acknowledgment request to the PS. This incoming signal acknowledgment request includes the IP address of the particular M-DTE.

When receiving the incoming signal acknowledgment request from the M-DTE, the PS sends an incoming signal acknowledgment message to the PBX through the CS. This incoming signal acknowledgment message includes information indicating a fact that the incoming signal is addressed to the IP address, a PS identification number for identifying the PS as the sender of the incoming signal acknowledgment request, and the IP address included in the above incoming signal acknowledgment request.

When receiving this incoming signal acknowledgment massage, the PBX verifies the PS by identifying the PS based on the PS identification number included in the incoming signal acknowledgment message. By doing so, rightness of the PS is ascertained. In case the incoming signal acknowledgment is determined as a correct acknowledgment from a right PS, the PBX performs a function for establishing a communication line between the PS and the control unit. That is, the PBX refers to the IP address included in the incoming signal notice message transmitted in the past for comparison with the IP address included in the incoming signal acknowledgment message received from the PS at this time. As a result of comparison, if both the addresses are in agreement with each other, a connection acknowledgment is sent to the control unit as a sender of the connection request which causes the transmission of the incoming signal notice message.

By doing so, a physical link is established between the PS and the control unit, and the packet data, which are transmitted from the DTE in the LAN and received by the control unit, are transmitted to the M-DTE via the route PBX, CS, PS in the in-business PC system.

In such an in-office PC system, a TDMA is generally used as a radio access system, and a TDD is used as a duplex system. For this reason, between the PS and the CS, packet data can be transmitted through a communication channel, and other signal and messages can be transmitted through a control channel which is used for controlling a wireless connection.

(4: Second Embodiment)

Fig. 4 is a diagram showing a connection sequence for transmitting packet data from the DTE to M-DTE in an in-enterprise mobile radio data communication system. In this embodiment, the incoming signal acknowledgment operation, which is performed by the M-DTE in

the first embodiment, is performed by th the PS. It should be noted that this incoming signal a acknowledgment operation may be performed by the ad adapter, instead of the PS body, which adapter has the task sk for converting a protocol between the PS and the M-D DTE.

In this embodiment, the PS stores es therein the IP address of the M-DTE which is to be c connected to the PS. As in the first embodiment described ed above, when the control unit receives the packet data a including the IP address addressed from the DTE in the ne LAN to the M-DTE, a connection request including tt the particular IP address of the M-DTE is sent from this c control unit to the PBX. Then, an incoming signal notice n message including the particular IP address is sent from m the PBX to the PS through the CS. At that time, the PS S judges whether or not the IP address included in this i incoming signal notice message is in agreement with th the IP address of the M-DTE connected to the PS. As a re result of the judgment, if both the IP addresses are in ag agreement, the PS sends an incoming signal acknowledg mment message to the PBX. And the PBX performs a proce cedure necessary for establishing a communication line b between the PS and the control unit in accordance wit th this incoming signal acknowledgment message.

When the communication line is established between the PS and the control unit in th this way, the PS sends an incoming signal connection n notice to the M-DTE to the effect that a communicati on can be performed. When receiving this notice, th the M-DTE activates an application software for recei eiving the packet data which is transmitted from the con ntrol unit via the PBX, CS, and PS. Of course, when the ne M-DTE is normally in the state ready to receive the p packet data, the PS may send the packet data to the M-D DTE without notifying the M-DTE of that a communicati ation can be performed.

In some instances, the packet data ta are frequently transmitted but in other instances, the p packet data are intermittently transmitted at time interv rvals. In order to cope with the latter case, when the pack cket data are not frequently received in spite of that the ie M-DTE is in a state able to receive packet data, the e communication line may be established between the PS S and the control unit only when packet data are sent to tt the M-DTE. The same is also applicable to the case wh here packet data are transmitted from the M-DTE to the D DTE in the LAN via the control unit. In order to make it jt possible to perform such controlling, an arrangement nt may be made such that an outgoing signal is transm mitted only when the PS or adapter receives a data trans rsmission request from the M-DTE and an incoming sign jnal acknowledgment for receiving packet data is mad de only when an incoming signal to the IP address is dete etected.

In this embodiment, the M-DTE is s not required to have a special function for an incoming g signal acknowledgment. Therefore, there are such adv advantages that the M-DTE can be simplified in structure.

(5: Third Embodiment)

In the first and second embodiments, a system is employed in which a communication line is established between the PS and the control unit when, the M-DTE or PS acknowledges the incoming signal from the control unit. In that system, however, the communication channel or path between the control unit and the PBX occupies the line irrespective of an acknowledgment of the incoming signal to be performed by the M-DTE or PS. This means that when neither the M-DTE nor the PS makes an acknowledgment of the incoming signal, the line is meaninglessly occupied. Thus, in this embodiment, between the router of the control unit and the TA, between the TA of the control unit and the PBX, and between the PBX and the CS, a message (incoming signal notice request message) for requesting an incoming signal notice at the IP address is sent, so that the M-DTE , that has received this notice, can call up the control unit, thus enabling to avoid such a meaningless occupation of line. Operation of this embodiment will be described hereinafter with reference to a connection sequence diagram of Fig. 5.

First, when receiving packet data from the DTE, the control unit confirms an addressee of this transmission signal based on the IP address included in the packet data. If the addressee of the packet data is the M-DTE, the particular packet data are reserved and an incoming signal notice request message including the IP address of the packet data is sent to the PBX without a need of occupying a line.

The PBX sends this incoming signal notice request message to the CS. Then, the CS takes out the IP address from this incoming signal notice request message and performs an incoming signal notice, which includes this IP address, to the PS. When receiving the incoming signal notice with respect to the IP address, the PS forms an incoming signal notice number using the IP address included in the incoming signal notice and sends this incoming signal notifying signal to the M-DTE.

The M-DTE judges whether or not the IP address included in this incoming signal notifying signal is in agreement with the IP address which is assigned to the particular M-DTE. If the judgment result is affirmative, the M-DTE requests the PS to send a signal to the control unit.

Examples of the method for requesting of an outgoing signal (call) to the control unit are as follows.

(a) The M-DTE preliminarily stores a telephone number (extension number) of the control unit in the memory unit and requests the PS to send an outgoing signal to this telephone number.

(b) The telephone number of the control unit, in addition to the IP address of the M-DTE, is included in the incoming signal notice request message which the control unit transmits, and the telephone

number of the control unit is notified toto the M-DTE
via the PBC, CS and PS. The M-DTE r. requests the
PS to send a signal to the telephone nununber which
received this notice.

The PS sends an outgoing signal in ι accordance
with the request thus made, and the PBX X notifies the
control unit of an incoming signal from the e PBX. Then,
when he control unit sends the incorroming signal
acknowledgment to the PS through the PB¾X, a commu-
nication path from the control unit to thehe M-DTE is
established. Confirming that the communiccication path is
established, the control unit transmits ththe reserved
packet data towards the M-DTE.

According to this embodiment, becausise an incom-
ing signal can be notified irrespective of thrhe number of
the communication paths between the conintrol unit and
the PBX, resources can effectively be utilizezed.

It should be noted that in this embodiniment, the M-
DTE which received the incoming signal ιl notice may
sends an outgoing signal to other control u unit than the
control unit which requested of the notice. F For example,
there is a possibility that in case the M-DTETE receives a
roaming service via a visitor PBX, packet datlata are trans-
mitted from the DTE of the LAN to the M-D'DTE, and the
control unit connected to a home PBX whicfch is the orig-
inal PBX of the M-DTE receives the packcket data and
lodges an incoming signal notice request. l. In this case,
the M-DTE, which received the incoming sisignal, sends
an outgoing signal designating a control u unit which is
currently connected to the visitor PBX whithich receives
the roaming service, instead of the controrol unit which
lodged the incoming signal notice request. t. The reason
is that the communication path can be macade shorter if
the above-mentioned arrangement is madide. However,
for adopting this method, it is required to satàtisfy the con-
ditions that a negotiation is made betweeren the control
units on the home PBX side and on the visitsitor PBX side
in the respect that the M-DTE calls up the cocontrol unit on
the visitor PBX side in response to an inccocoming signal
notice request lodged by the control unit o on the home
PBX side.

⟨6: Fourth Embodiment⟩

Fig. 6 is a diagram showing a connecticicion sequence
for transmitting packet data from the DTE toto the M-DTE
in a mobile radio data communication systerem according
to the fourth embodiment of the present it invention. It
should be noted that this embodiment is a a combination
of the second embodiment and the third emmbodiment.

First, when receiving packet data from th the DTE, the
control unit confirms an addressee of this ti transmission
signal based on the IP address included irin the packet
data. If the addressee of the packet data is is the M-DTE,
the particular packet data are reserved and d an incoming
signal notice request message including thehe IP address
of the packet data is sent to the PBX withoιout a need of

occupying a line.

The PBX sends this incoming signal notice request
message to the CS. Then, the CS takes out the IP
address from this incoming signal notice request mes-
sage and performs an incoming signal notice, which
includes this IP address, to the PS.

The PS preliminarily stores the IP address of the M-
DTE connected to the PS in the memory unit. When
receiving the incoming signal notice, the PS judges
whether or not the IP address included in this incoming
signal notice is in agreement with the IP address in the
memory unit, i.e., whether or not there is an incoming
signal to the IP address of the M-DTE. If the judgment
result is affirmative, the PS sends a signal to the prelim-
inarily stored telephone number (extension number),
and the PBX notifies the control unit of the incoming sig-
nal from the PBX. When the control unit sends an
incoming signal acknowledgment to the PS through the
PBX, a communication path from the control unit to the
MDTE is established. When confirming that the commu-
nication path is established, the control unit transmits
the reserved packet data towards the M-DTE.

Here, in order for the control unit to transmit packet
data to the M-DTE, it is necessary that the control units
recognizes the incoming signal from the M-DTE. Meth-
ods for fulfilling the above requisite are as follows.

(a) The PS sends an outgoing signal request
including therein the ID address of the M-DTE and
sends the IP address further to the control unit
through the CS and PBX. This control unit recog-
nizes the incoming signal from the M-DTE by
receiving the IP address of the M-DTE.

(b) Packet data are sent from the M-DTE to the con-
trol unit after the communication path is estab-
lished. The control unit recognizes the M-DTE from
the IP address (i.e., IP address of the M-DTE) of the
sender included in the packet data.

⟨7: Fifth Embodiment⟩

In the first through fourth embodiments, only one
kind of packet address (IP address) is assigned to the
M-DTE. This embodiment is intended to cope with a
case where a plural kinds of packet addresses are
assigned to a single M-DTE.

That is, the system according to this embodiment
includes a LAN controlled by other protocol than the IP,
in addition to the LAN controlled by the IP protocol. Tel-
ephone lines (including ISDN) of the PBX are con-
nected to the control units of the respective LANs. The
DTE belonging to the respective LANs can send and
receive the packet data between the M-DTE in accord-
ance with the respective protocols. The packet
addresses used at that time are determined so as not to
be duplicated between the LANs.

Therefore, presuming that three kinds of LANs,

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LAN 1, LAN 2 and LAN3, are provideded in the system, the M-DTE is assigned with three ki kinds of packet addresses corresponding to those LANs Ns.

When the M-DTE sends and receiveives packet data between the DTE in the respective LAIANs, it becomes necessary that a physical link is estabiblished between the PS and the control unit. The control ol unit as the connecting end of the PS is different depeiending on which LAN's DTE becomes the counterpart o of the communication. That is, when the M-DTE receieives the packet data 1 from the DTE 1 in the LAN 1, it is is necessary that the control unit 1 of the LAN 1 is conneiected to the PS. When from the DTE 2 in the LAN 2, it is is necessary that the control unit 2 of the LAN 2 is conneiected to the PS. When from the DTE 3 in the LAN 3, it is is necessary that the control unit 3 of the LAN 3 is conneœcted to the PS.

Therefore, when an incoming signalal is notified from the DTE of the LAN, it becomes an impmportant problem that how the M-DTE or PS side can be ·e connected to a correct control unit.

In this embodiment, as in the firstst through fourth embodiments, the M-DTE and the coront rol unit of the LAN is connected by sending an incomining signal notice message, etc., including the packet adcddress of the M-DTE from the LAN side via the PBiBX. The packet addresses included in the incoming sigignal notice message, etc. are also different depending g on which LAN. That is, although the incoming signal n·notice message, etc. sent to the PS through the PBX inclcludes the packet address of the M-DTE, this packet addreress is the packet address 1 used in the LAN 1 when ththe sender is the control unit 1 of the LAN 1. But the packcket address is the packet address 2 used in the LAN 2 whdhen the sender is the control unit 2 of the LAN 2, and the e packet address 3 used in the LAN 3 when the sender is is the control unit 3 of the LAN 3.

This embodiment utilizes the aboveie fact so that the PS can be connected to proper controlol unit. As a specific system, there can be contemplateted four kinds of systems in which the technical coconcepts so far described are applied to the first througigh fourth embodiments.

〈7-1: System Corresponding to First Enimbodiment〉

First, a system in which the technicical concepts are applied to the first embodiment is descritribed. In this system, presume that the DTE 1 of the L LAN 1 transmits packet data to the M-DTE 1. In this case,ie, the control unit 1 of the LAN 1 receives this packet datata 1. The control unit 1 reserves the packet data 1 and reiequests the PBX of an incoming signal to the packet acaddress 1 in the packet data. The PBX establishes a ı communication path for the control unit 1 and notifiesʒs the CS of the incoming signal to the packet address 1 1. The CS transmits an incoming signal notifying signænal including the packet address 1 to the PS.

When receiving the incoming signalal notifying signal

including the packet address, the PS transmits the incoming signal including the packet address to the M-DTE. Here, the M-DTE stores therein a packet address table comprising the packet address 1 corresponding to LAN 1, a packet address 2 corresponding to LAN 2, and a packet address 3 corresponding to LAN 2, as a packet address for identifying the M-DTE. The M-DTE refers to the packet address included in the received incoming signal notifying signal for comparing with each packet address in this address table. In this case, since the packet address 1 is included in the incoming signal notifying signal, the M-DTE requests the PS of an acknowledgment of the incoming signal to the packet address 1. Upon receipt of this request, the PS transmits an acknowledgment signal including the packet address 1 to the CS.

The CS establishes a communication path with respect to the PS and at the same time, transmits an acknowledgment signal for the incoming signal addressed to the packet address 1. When receiving the acknowledgment signal for the incoming signal addressed to the packet address 1, the PBX judges whether or not there is one in the incoming signal request for the packet address which corresponds to the packet address 1. In this case, among the incoming signal request received by the PBX, there is the incoming signal request including the packet address 1 which the control unit 1 transmitted. For this reason, the PBX establishes a communication path between the CS and at the same time, transmits an acknowledgment signal to the control unit 1.

When receiving an acknowledgment signal from the PBX, the control unit 1 recognizes that packet data can now be sent and received between the M-DTE, and transmits the reserved packet data 1 to the M-DTE. Thereafter, a sending and receiving operations are started between the M-DTE and the LAN 1.

〈7-2: System Corresponding to Second Embodiment〉

Next, a system in which the technical concepts are applied to the second embodiment is described. In this system, presume that the DTE 1 of the LAN 1 transmits packet data to the M-DTE 1. In this case, the procedure is the same as the system corresponding to the first embodiment up to the procedure for transmitting the incoming signal notifying signal including the packet address 1 to the PS.

In this system, the PS stores therein a packet address table for the packet address corresponding to each LAN for identifying the M-DTE. When receiving the incoming signal notifying signal sent from the CS in the manner as mentioned above, the PS refers to the packet address included in the received incoming signal notifying signal for comparing with each packet address in this address table. In this case, since the packet address 1 is included in the incoming signal notifying signal, the PS requests the CS of an acknowledgment

of the incoming signal to the packet address 1. At the same time, the PS notifies the M-DTE of the incoming signal. The M-DTE is established in a state capable of sending and receiving packet data by the incoming signal notice from this PS. It should be noted that the M-DTE may be established in a state capable of sending and receiving packet data at the time the first packet data are received. In the alternative, it may preliminarily be established in a state capable of sending and receiving packet data.

The CS establishes a communication path with respect to the PS, and at the same time, it transmits an acknowledgment signal for the incoming signal addressed to the packet address 1 to the PBX. When receiving the acknowledgment signal for the incoming signal addressed to the packet address 1, the PBX judges whether or not there is one in the incoming signal request for the packet address which is in corresponding relation with the packet address 1. In this case, among the incoming signal request received by the PBX, there is the incoming signal request including the packet address 1 which the control unit 1 transmitted. For this reason, the PBX establishes a communication path between the CS and at the same time, transmits an acknowledgment signal to the control unit 1.

When receiving an acknowledgment signal from the PBX, the control unit 1 recognizes that packet data can now be sent and received between the M-DTE, and transmits the reserved packet data 1 to the M-DTE. Thereafter, a sending and receiving operations are started between the M-DTE and the LAN 1.1.

(7-3: System Corresponding to Third Embodiment)

Next, a system in which the technical concepts are applied to the third embodiment is described. Operation of this system is described with reference to Fig. 7.

In this system, presume that the DTE 1 of the LAN 1 transmits packet data to the M-DTE 1. In this case, the control unit 1 of the LAN 1 receives this packet data. The control unit 1 reserves the packet data 1 and requests the PBX of the incoming signal notice to the packet address 1 in the packet data. The PBX requests the CS of the incoming signal notice to the packet address 1 without establishing a communication path with respect to the control unit 1. The CS notifies of the incoming signal by the packet address 1.

When receiving the incoming signal including the packet address, the PS transmits the incoming signal including the packet address to the M-DTE. Here, as exemplified in Fig. 7, the M-DTE stores therein a table which defines a corresponding relation among the packet address, the connection end number (i.e., telephone number of the control unit) corresponding thereto, and an application software for sending and receiving packet data between the control unit. Since the packet address 1 is included in the incoming signal,

the M-DTE reads the connection end number 1 (telephone number of the control unit 1) corresponding to the packet address 1, and requests the PS of a call for this connection end number 1.

In response to this request, the PS makes a calling to the connection end number 1. At the same time, the PS notifies the M-DTE of the incoming signal. The M-DTE is established in a state capable of sending and sending the packet data by the incoming signal notice from the PS. It should be noted that the M-DTE may be established in a state capable of sending and receiving the packet data at the time the first packet data are received. In the alternative, it may preliminarily be established in a state capable of sending and receiving packet data.

The CS establishes a communication path between the PS, and at the same time, transmits a request for an outgoing signal to the connection end number 1, to the PBX. The PBX transmits an incoming signal to the control unit 1.

When receiving this incoming signal, the control unit 1 transmits an acknowledgment signal to the PBX. When receiving this acknowledgment signal, the PBX establishes a communication path between the PS. Here, the call signal from the PS includes the packet address 1 and this packet address 1 is transmitted to the control unit 1. Therefore, the control unit 1 can recognize the connection of the M-DTE having the packet address 1 by receiving this packet address 1. Then, the control unit 1 judges that the packet data can now be sent and received between the M-DTE and transmits the reserved packet data 1 to the M-DTE. Thereafter, a sending and receiving of the packet data are started between the M-DTE and the LAN 1.

As a method for the control unit 1 to recognize the M-DTE as a counterpart of connection, a method may be employed in which packet data are sent from the M-DTE to the control unit 1 after connection, and the control unit 1 recognizes the M-DTE from the sender's address included in this packet data.

(7-4: System Corresponding to Fourth Embodiment)

Next, a system in which the technical concepts are applied to the fourth embodiment is described. Presume that in this system, the DTE 1 of the LAN 1 transmits packet data to the M-DTE 1. In this case, the procedure is the same as the system corresponding to the first embodiment up to the procedure for transmitting the incoming signal notifying signal including the packet address 1 to the PS.

In this system, the PS stores therein the table exemplified in Fig. 7. Since the packet address 1 is included in the incoming signal notifying signal, the PS reads the connection end number 1 (telephone number of the control unit 1) corresponding to the packet address 1 from the table and makes a call for this connection end number 1 to the PS. At the same time, the

PS notifies the M-DTE of the incomingig signal. The M-DTE is established into a state capablele of sending and receiving the packet data by the incomining signal notice from the PS. It should be noted that the e M-DTE may be established into a state capable of sendhding and receiving the packet data when the first pipacket data are received. In the alternative, it may also p preliminarily be established into a state capable of receieiving the packet data.

The CS establishes a communicatioion path between the PS and at the same time, sends an n outgoing signal request for the connection end numberer 1 to the PBX. The PBX transmits an incoming signal toto the connection end No. 1, i.e., control unit 1.

When receiving this incoming sigrgnal, the control unit 1 transmits an acknowledgment sigignal to the PBX. When receiving this acknowledgment ε signal, the PBX establishes a communication path beietween the PS. Here, the call signal from the PS incluJudes the packet address 1 and this packet address 1 is is transmitted to the control unit 1. Therefore, the controtol unit 1 can recognize the connection of the M-DTE hanaving the packet address 1 by receiving this packet addrdress 1. Then, the control unit 1 judges that the packet dzdata can now be sent and received between the M-DTB'E and transmits the reserved packet data 1 to the M-DTITE. Thereafter, a sending and receiving of the packet didata are started between the M-DTE and the LAN 1.

As a method for the control unit 1 te to recognize the M-DTE as a counterpart of connection,n, a method may be employed in which packet data are s· sent from the M-DTE to the control unit 1 after connectidion, and the control unit 1 recognizes the M-DTE frorom the sender's address included in this packet data.

(8: Sixth Embodiment)

In the above examples, the in-office·e PC system and the LAN are connected in the in-enterpriorise communication system.

However, the present invention shdcould not be limited to those examples, and the in-office:e PC system can also be applied to a general mobile c communications network (public PC network, radio call, c cellular network, etc.)

Thus, the sixth embodiment is delescribed next in which packet data are transmitted fromn the DTE under the control of the LAN side to a data commmunication terminal equipment through a PS under t the control of a mobile communications network. Thisis sixth embodiment transmits a signal from the CS to ththe PS as a message of a pager.

(8-1: Communication System)

Fig. 8 is a block diagram showing a a configuration of a mobile radio data communication syststem to which the sixth embodiment is applied. In this F Figure, portions common to Fig. 1 are denoted by identical reference numerals. In this embodiment, the protocol on the LAN 21 is explained as TCP/IP used in the Internet, etc. as in Fig. 1.

Of course, if the "IP address" under explanation is replaced by other corresponding routing address, this can also be applied to data communications network having other protocols.

As shown in the illustration, the LAN 21is connected to a general public line 30 and a mobile communications network 40 through the control unit 23. The general public line 30 is connected with a pager exchange 51, and the pager exchange 51 is connected with a pager transmitting station 52. The existing one can be used for all of them. The mobile communications network 40 includes cell stations 41, 42, • • • which are wirelessly connected with mobile stations.

The mobile data terminal equipment (M-DTE) 14 is a data terminal such as portable computer, high performance PDA, etc. The M-DTE 14 is connected to a mobile station (hereinafter referred to as MS) 113. The MS 113 includes memory means such as flush memory, not shown, for storing therein an IP address assigned to the M-DTE and a telephone number of the control unit 23, and the like.

The MS 113 includes data sending/receiving means for sending and receiving data by sending an outgoing signal to the control unit 23 through the cell stations 41, 41, • • •, message receiving means for receiving a message coming from a pager transmitting station 52, and judgment means 23 for supplying the M-DTE 14 with a data message indicating that the IP address stored in the memory means is in accord, when such is the case, with the IP address included in the message received by the message receiving means, sending an outgoing signal to the control unit 23 through the data sending/receiving means, and transmitting the particular IP address to the control unit 23 after a communication path is established.

A method for realizing the data sending/receiving means and the message receiving means in the MS 113 will now briefly be described.

Recently, the communication path is increasingly digitized in the field of mobile communication, and a comparatively high speed transmission is realized, utilizing a digital mobile data communication system. There are several types of such digital mobile data communication system, such as PDC (Personal Digital Cellular), PHS (Personal Handy-phone System), etc. As the MS, a terminal integrally formed of the PHS and pager is already available in the market. If those techniques are utilized, the MS 113 including the data sending/receiving means and the message receiving means can be realized. It should be noted that at least an existing service capable of message transmission by way of numerical figures can be utilized as paging service (pager exchange 51 and pager transmitting station 52).

On the other hand, the control unit 23 includes, as

in Fig. 1, the router 23a and the TA 23b. Thi̇hus, the control unit 23 makes it possible to enjoy a reremote access from outside to the LAN 21 through the motobile communications network 40, etc. Among them, thḋe router 23a performs a routing of the packet data from n the DTE 22 on the LAN side based on the IP address inc̣ncluded in the particular packet data. The TA 23b terminạnates a serial line between the general public line 30, ι receives an incoming signal from the general public li line 30, and sends an outgoing signal to the general puḃublic line 30.

The control unit 23 includes a memory ỵ unit such as RAM (Random Access Memory), hard disḋisk, etc. The control unit 23 stores in the memory unit thėe IP address assigned to the M-DTE 14 by way of corresṗsponding the particular IP address to group informatidion (as later described) of the message receiving meanıns in the MS 113. When the IP address included in the ararrived packet data is in agreement with the one assigneied to the M-DTE 14, the control unit 23 temporarily rɩ reserves the packet data sends an outgoing signal to̓to the pager exchange 51 with a common pager numbeịer commonly established to the subscribers, via the geịeneral public line 30, so that the IP address to which thṫhe particular packet data are addressed, is transmitteḋed by way of paging, via the general public line 30, pagȩger exchange 51, and pager transmitting state 52.

Although, Fig. 8 does not show one coịorresponding to the PBX of Fig. 1, no inconvenienceɛe will occur because the general public line 30 usually ḣ has a plurality of exchanges for changing the line fɪ from one to another. Also, the mobile communications ıs network 40 has an exchange for changing the line fɪ from one to another for the cell stations which are wirɑirelessly connected to the MS 113. For this reason, in tɪ this embodiment, the role that the PBX of Fig. 1 has, iȿ is had by the exchanges of the general public one 30 Ɔ and mobile communications network 40.

(8-2: Assignment and Registration Proceduɔure of IP Address)

In the communication system having g the above-mentioned configuration or architecture, it iȿ is necessary that an IP address is assigned to the M-DȚTE 14 by the address management server 24 in the LАIAN 21 before the M-DTE 14 is connected to the LAN 2̇21. Also, it is necessary that this IP address is stored in n the MS 113 and registered in the control unit 23. Thus, tĺ those procedures are described next.

The IP address, which has been paiạid out of the address management server 24 on the L LAN 21 and assigned, is temporarily stored in the M-DṬTE and then, transmitted to and stored in memory meanıns of the MS 113 by way of a predetermined sequentiạial steps. For example, in case the M-DTE 14 and the ʁ MS 113 are physically separated, the IP address is ȿ transmitted through a PC card standard interface, etc. a and stored in the memory means of the MS 113, alạlthough this

sequential steps is not particularly limited.

Fig. 9 is a block diagram showing function models of the MS 113 and the M-DTE 114. As illustrated in this Figure, originally, the MS 113 reserves an ID as a pager (this ID is hereinafter referred to as "pager ID"), and an ID as a terminal for sending and receiving data through the cell stations 41, 42, · · · (this ID is hereinafter referred to as "terminal ID"). Those Ids are assigned to subscribers by respective service providers when the subscribers' application for services are accepted and become usable for various services when written into the internal memory means, for example. As previously mentioned, the IP address is stored in the memory means of the MS 113 together with those IDs.

Registration of the IP address can be made by any suitable conventional means, such as on-line procedure on a communication path established between the M-DTE 14 and the control unit 23, for example. As previously mentioned, the control unit 23 stores therein the IP address such that the IP address is in corresponding relation to the group information of the message receiving means of the MS 113.

The terms "group information" used here refer to information (for example, call number) indicating the group of the mobile terminal (message receiving means) for notifying via the pager exchange 51 and pager transmitting station 52.

If the number of mobile terminal equipment devices, which ask for a remote access to the LAN 21, is equal to or less than the number which can be accommodated in the same group, a group registration can be eliminated by grouping those mobile terminal equipment devices into the same group. It is also acceptable that a message solely composed of the IP address is sent to a certain group, and a message including the sender's information of the packet, as well as the IP address is notified to other group, so that the group information can be utilized for versatility and separation of services.

It should be noted here that the router portion 23a of the control unit 23 is not required to store therein the pager ID of the MS 113, ID of the terminal equipment devices, and telephone numbers. That is, the control unit 23 can well be unconscious of the physical address of the M-DTE 14.

(8-3: Packet Transmission Procedure From LAN 21 side To M-DTE 14)

Next, referring to Fig. 10, there is described a procedure for transmitting packet data when it occurs to transmit packet date addressed to the M-DTE 14 in the LAN 21. Presume that the IP address corresponding to the M-DTE is registered in the router 23a of the control unit 23 such that the IP address is in corresponding relation with the group information. It is also presumed that the MS 113 is in a position ready to received a message from the pager transmitting station 52.

Under the above circumstance, wh/hen packet data addressed to the registered IP addreress arrives, the router portion 23a of the control unit 23 β performs a paging procedure via the TA 23b. The termsıs "paging procedure" used here refers to a procedure fofor sending same massages to a plurality of pagers whichch are registered as a group. The services for sending saneme massages to a plurality of pagers which are registereded as a group, are services which general paging service:e facilities have. The services are put into practice wh/hen a message transmission is requested by indicating a a call number for the group. Of course, it is presumed thatat a registration is preliminarily made such that the MS 1ı113 belongs to a group which can be identified by a call ıl number used in paging procedure by the control unit 23.3.

When the control unit 23 sends à a signal to the pager exchange 51 with the call numberer for a particular group and requests a transmission of a n message including the IP address addressed by the paıacket data which have just arrived (this packet data is hererereinafter referred to as "arrived packet data"), this messaığage is notified to each MS including the MS 113 which isis registered as a group, through the pager exchange 51ı1 and the pager transmitting station 52.

When the above message is receivıived, the MS 113 refers to the content of the received menessage for comparison with the preliminarily registereced IP address. If the result of the comparison reveals thaıat the content of the received message is not in agreemenent with the preliminarily registered IP address, the MSIS 113 is brought back again into the position for waitingıg a further massage. In contrast, if the content of the receceived message is in agreement with the preliminarilyily registered IP address, an outgoing signal is sent to thdhe control unit 23 via the nearest cell station (for example,e, cell station 41) and a communication path is establishdhed because the packet data addressed to the M-DTE 14 4 are supposedly arrived.

When the communication path is eststablished, a signal as an acknowledgment of the packetet data, including the received IP address (IP address s stored in own memory) is sent back from the MS 113 tı to the router 23a of the control unit 23 and a receipt of thdhe packet data is requested. The router 23a transmits ı the temporarily reserved arrived packet to the M-DTE Ξ 14 through the communication path. Thereafter, a two-o-way data communication is performed as in the oıordinary remote access.

(8-4: Summary)

As explained hereinbefore, accordiding to the sixth embodiment, the MS includes the mesessage receiving means and the data sending/receiving ŋ means, and the control unit notifies all terminal equipmerent devices in the group of a message including the IP addldress addressed by the arrived packet data. Accordinglyıly, each MS can know the existence of a packet arrivaıal addressed to

itself by comparing the IP address included in the received message and its own IP address. Thus, each MS can instantaneously respond to a call from the LAN side. As a consequence, a communication, in which an immediate response is expected as in the case with Internet phone, etc., can smoothly be realizıed.

Moreover, the MS stores therein the IP address. Accordingly, the MS can make a judgment whether or not an outgoing signal may be sent to the control unit by comparing the content of the arrived message with the IP addressed which the MS itself stores. If it is designed such that when the judgment result is affirmative, the MS itself turns the power source on automatically, power consumption can be reduced.

Furthermore, since paging services are used, there are such advantages that no facilities for relaying the packet data are required to be provided in the mobile communications network. Moreover, because the existing paging services can be used, a communication system can be built up easily without a need of extensive change of the existing system structure. Furthermore, since it is no more required such troublesome procedures as storing the telephone number to each MS in the control unit and obtaining a corresponding relationship between the IP address, a communication system can be built up easily without making the structure of the control unit complicated.

It should be appreciated that although, in the sixth embodiment, the MS itself compares the received IP address as in the second and fourth embodiments, this job may be undertaken by the M-DTE side as in the first and third embodiments.

Moreover, although an example is shown in the sixth embodiment in which a communication path is established using a mobile communications network, the communication path may be established merely through a fixed network. In that case, instead of the MS, a fixed terminal such as model, DSU (Digital Service Unit), etc. is connected to a data communication terminal equipment so that a communication path can be established through the fixed terminal. Of course, the fixed terminal is required to have the function of a pager.

(9: Modified Embodiment)

With respect to the first through sixth embodiments so far described, the following modifications and application can be contemplated.

In the first through sixth embodiments, although the notice of an arrived packet data and the content of the paging are served as the IP address addressed to the arrived packet, other data than the IP address may be included therein.

As data other than the IP address, firstly, a sender's address, kinds of application software of the sender, and the like can be listed. Upon receipt of such data, the radio mobile station side can selectively respond or not respond depending on the sender's address, or

depending on presence or non-presence of of a software which is compatible with the sender's appplication software. Of course, in this case, if the M-D-DTE as the addressee of the arrived packet is in a nonin-responding state, a procedure to be performed by the control unit must be preliminarily established.

Secondly, as data other than the IP P address to included, there can be contemplated not c only characters such as numerical figures, symbols, ei etc., but also video data, voice data, and the like.

Control channels used for transmitting g a notice of an arrival and paging channels used for traransmission of a message originally have a property capalable of transmitting any kind of information. Therefore, i, the existing services can also be used for transmitting g video data, voice data, etc. as a message. For this reascson, only if an arrangement can be made such that the e control unit side reads data located in a particular bit of of the arrived packet and transmits the same to the radioio mobile station, and that the PS, CS or M-DTE side e offers such video image voice data, etc. indicated by th the particular data, an application area of the present inverention is widened. In actual practice, it should be arrangiged such that the kinds of data can reliably be identified, f, for example, by changing the channel to be used in acccordance with the kind of data.

Claims

1. A method of packet data transmission n in a mobile radio data communication system cccomprising a personal station, a mobile data terminaial equipment to be connected to said personal statioron, a wireless connection equipment for performing g a wireless connection with said personal station, a an exchange for connecting said personal station arund a counterpart thereòf through said wireless s connection equipment, a LAN, a data terminal ecpquipment on the LAN side connected to said LAN, ai and a control unit for performing a transmission contntrol of packet data in said LAN and a transmissioron control of packet data between said exchange anund said LAN,

    characterized in that said mobilele data terminal equipment is assigned with a packexet address to be used in said LAN, and said control uiunit is preliminarily stored therein a packet address 6 corresponding to said mobile data terminal equipmment;

    when transmitting packet data toto said mobile data terminal equipment, said LAN sidcle data terminal equipment transmits packet data a including a packet address of said mobile data ternrminal equipment to said LAN;

    if the packet address included ir in the packet data received through said LAN is s the packet address of said mobile data terminal al equipment, said control unit reserves the packexet data and requests said exchange to connect toto the packet address;

when requested a connection to the packet address, said exchange establishes a communication path for said control unit and transmits a signal including the packet address to said personal station through said wireless connection equipment;

if the packet address included in said signal is a packet address corresponding to said mobile data terminal equipment, said personal station transmits an acknowledgment signal;

when receiving the acknowledgment signal through said wireless connection equipment, said exchange acknowledges the connection to said packet address to said control unit; and

when receiving the acknowledgment from said exchange, said control unit transmits the reserved packet data to said mobile data terminal equipment.

2. A method of packet data transmission in a mobile radio data communication system according to claim 1, wherein when receiving a signal through said wireless connection equipment, said personal station transmits the packet address included in the signal to said mobile data terminal equipment;

    when receiving the packet address, said mobile data terminal equipment judges whether or not the packet is its own packet address and if the result of judgment is affirmative, requests said personal station to acknowledge an incoming signal; and

    when requested the acknowledgment of an incoming signal by said mobile data terminal equipment, said personal station transmits an acknowledge signal.

3. A method of packet data transmission in a mobile radio data communication system according to claim 1, wherein when receiving a signal through said wireless connection equipment, said personal station judges whether or not the packet address included in the signal is a packet address of said mobile data terminal equipment, and if the judgment result is affirmative, transmits an acknowledgment signal.

4. A method of packet data transmission in a mobile radio data communication system according to claim 1, wherein said personal station includes the packet address of said mobile data terminal equipment in the acknowledgment signal and transmitting the same; and

    when receiving the acknowledgment signal through said wireless connection equipment, said exchange judges whether or not the packet address included in the acknowledgment signal is the packet address included, in the incoming signal acknowledgment and only when the result of judgment is affirmative, responds to said control unit for

connection to the packet address.

5. A method of packet data transmisssion in a mobile radio data communication systemem according to claim 1, wherein a plurality of packetet addresses are assigned to said mobile data termminal equipment, and when an incoming signal is rereceived for any one of those packet addresses, a p personal station connected to said mobile data termrminal equipment is connected to a control unit whihich is predetermined with respect to the packet adiddress.

6. A method of packet data transmissssion in a mobile radio data communication systemem according to claim 1, wherein said wireless coronnection equipment transmits a signal includiriding the packet address to said personal station thrhrough said control channel used for connection corontrol.

7. A method of packet data transmisssssion in a mobile radio data communication systemem according to claim 1, wherein said wireless coronnection equipment transmits a signal containining the packet address to said personal station tl through a message channel for radio call.

8. A method of packet data transmisssssion in a mobile radio data communication systemm comprising a personal station, a mobile data termrminal equipment to be connected to said personal statation, a wireless connection equipment for performming a wireless connection with said personal statioion, an exchange for connecting said personal stationn and a counterpart thereof through said wirelleless connection equipment, a LAN, a data terminalal equipment on the LAN side connected to said LAMN, and a control unit for performing a transmission cv control of packet data in said LAN and a transmisiission control of packet data between said exchangege and said LAN,

    characterized in that said monobile data terminal equipment is assigned with a paoacket address to be used in said LAN, and said contrdtrol unit is preliminarily stored therein a packet addréress corresponding to said mobile data terminal equuquipment;

    when transmitting packet datata to said mobile data terminal equipment, said LAN ℵ side data terminal equipment transmits packet didata including a packet address of said mobile data a terminal equipment to said LAN;

    if the packet address includeled in the packet data received through said LAN N is the packet address of said mobile data termininal equipment, said control unit reserves the paoacket data and requests said exchange to notify c of the incoming signal to the packet address'

    when requested a notice of a an incoming signal to the packet address, said exchihange and transmits a signal including the packet a address to said

personal station through said wireless connection equipment without establishing a communication path for said control unit;

    if the packet address included in said signal is a packet address corresponding to said mobile data terminal equipment, said personal station transmits a call signal to said control unit;

    said exchange transmits an incoming signal to said control unit in response to the call signal through said wireless connection equipment;

    when receiving the incoming signal, said control unit transmits an acknowledgment signal to said exchange;

    when receiving the acknowledgment, said exchange establishes a communication path between said control unit and said personal station; and

    said control unit transmits the reserved packet data to said mobile data terminal equipment through said communication path.

9. A method of packet data transmission in a mobile radio data communication system according to claim 8, wherein when receiving a signal through said wireless connection equipment, said personal station transmits the packet address included in the signal to said mobile data terminal equipment;

    when receiving the packet address, said mobile data terminal equipment judges whether or not the packet is its own packet address and if the result of judgment is affirmative, requests said personal station of a call signal; and

    when requested of a call signal from said mobile data terminal equipment, said personal station transmits a call signal.

10. A method of packet data transmission in a mobile radio data communication system according to claim 8, wherein when receiving a signal through said wireless connection equipment, said personal station judges whether or not the packet address included in the signal is a packet address of said mobile data terminal equipment, and if the judgment result is affirmative, transmits a call signal.

11. A method of packet data transmission in a mobile radio data communication system according to claim 8, wherein a plurality of packet addresses are assigned to said mobile data terminal equipment, and when an incoming signal is received for any one of those packet addresses, a personal station connected to said mobile data terminal equipment is connected to a control unit which is predetermined with respect to the packet address.

12. A method of packet data transmission in a mobile radio data communication system according to claim 8, wherein said wireless connection equip-

ment transmits a signal including ¡ the packet
address to said personal station througgh said con-
trol channel used for connection controtol.

13. A method of packet data transmission·n in a mobile
    radio data communication system a·according to
    claim 8, wherein said wireless conne·ection equip-
    ment transmits a signal containing ¡ the packet
    address to said personal station throıough a mes-
   sage channel for radio call.

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FIG. 1

11M: HM

· PHYSICAL ADDRESS
· LOCATION INFORMATION
· VERIFICATION INFORMATION
PHYSICAL ADDRESS: 3

23: CONTROL UNIT

22: LAN SIDE DTE

21: LAN

IP ADDRESS: A

TELEPHONE SET

19

ROUTER

23a

TA

23b

PHYSICAL ADDRESS: 2

20: LAN SYSTEM

12: CS

12

11: PBX

13: PS

13a

13b

14: M-DTE

IP ADDRESS: B   PHYSICAL ADDRESS: 1

10: PC SYSTEM

FIG. 2

FIG. 3

FIG. 4

FIG. 5

FIG. 6

FIG. 7

| PACKET ADDRESS	CONNECTION END NUMBER	APPLICATION
1	○○○○	A
2	△△△△	B
3	× × × ×	C
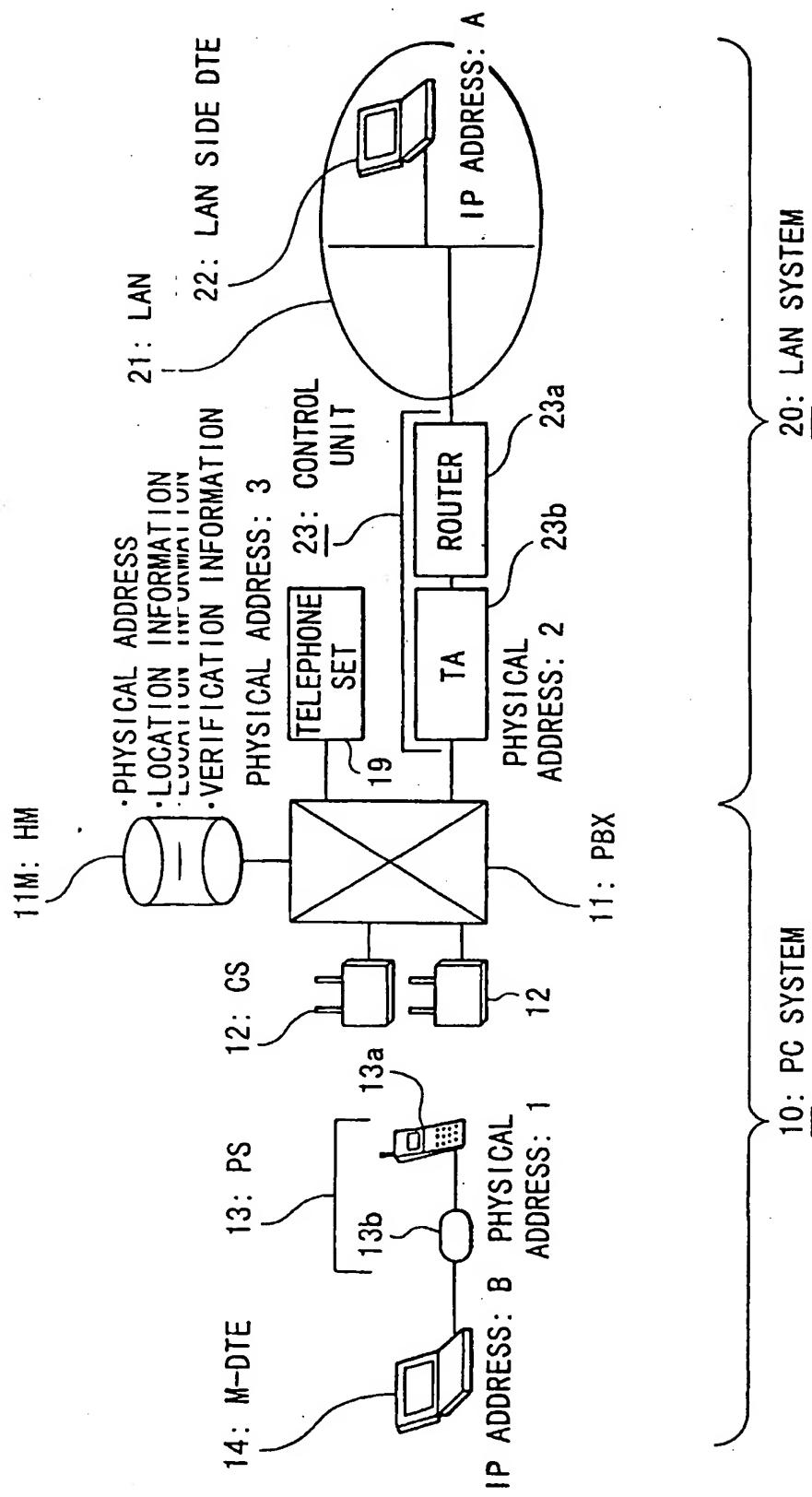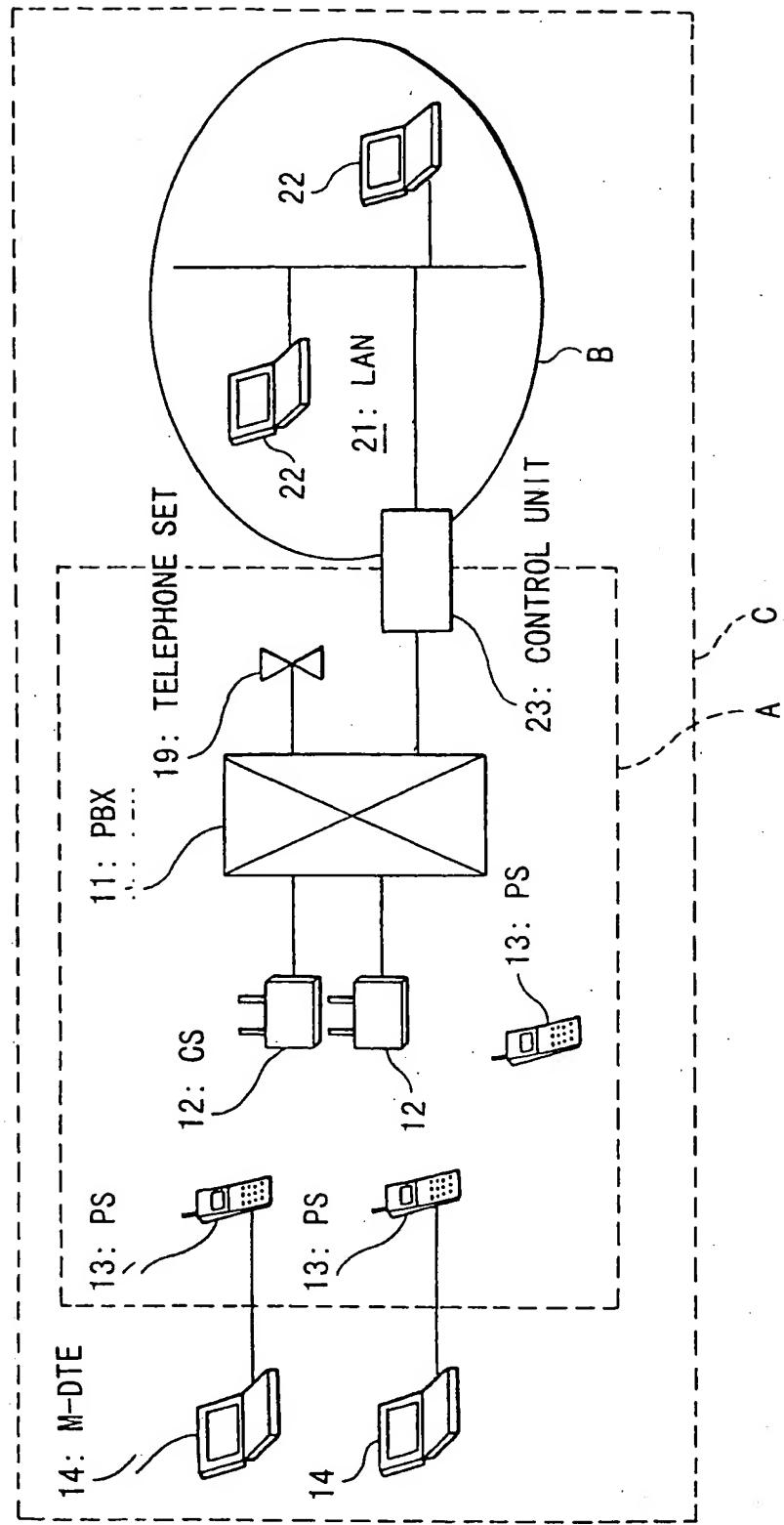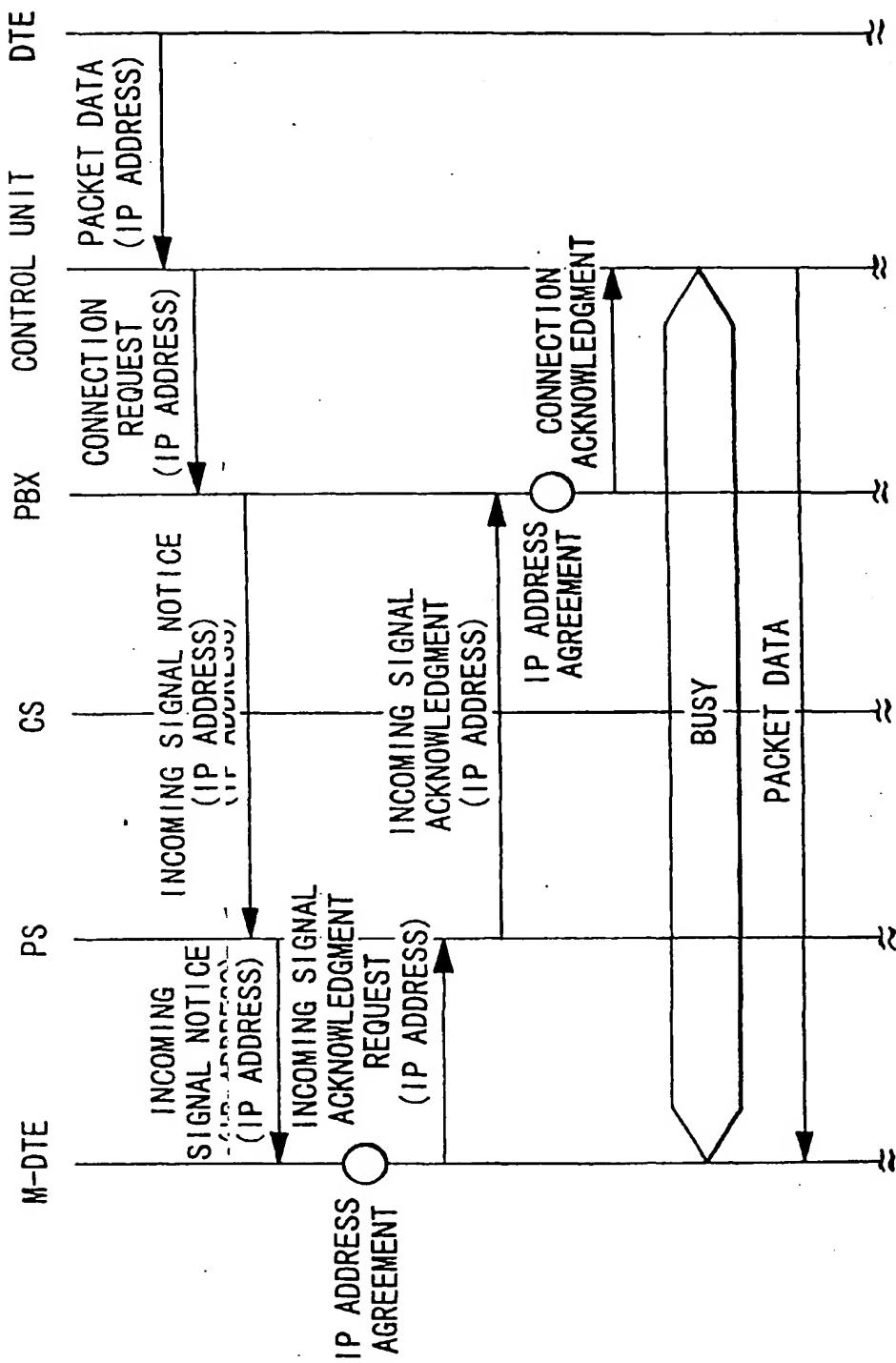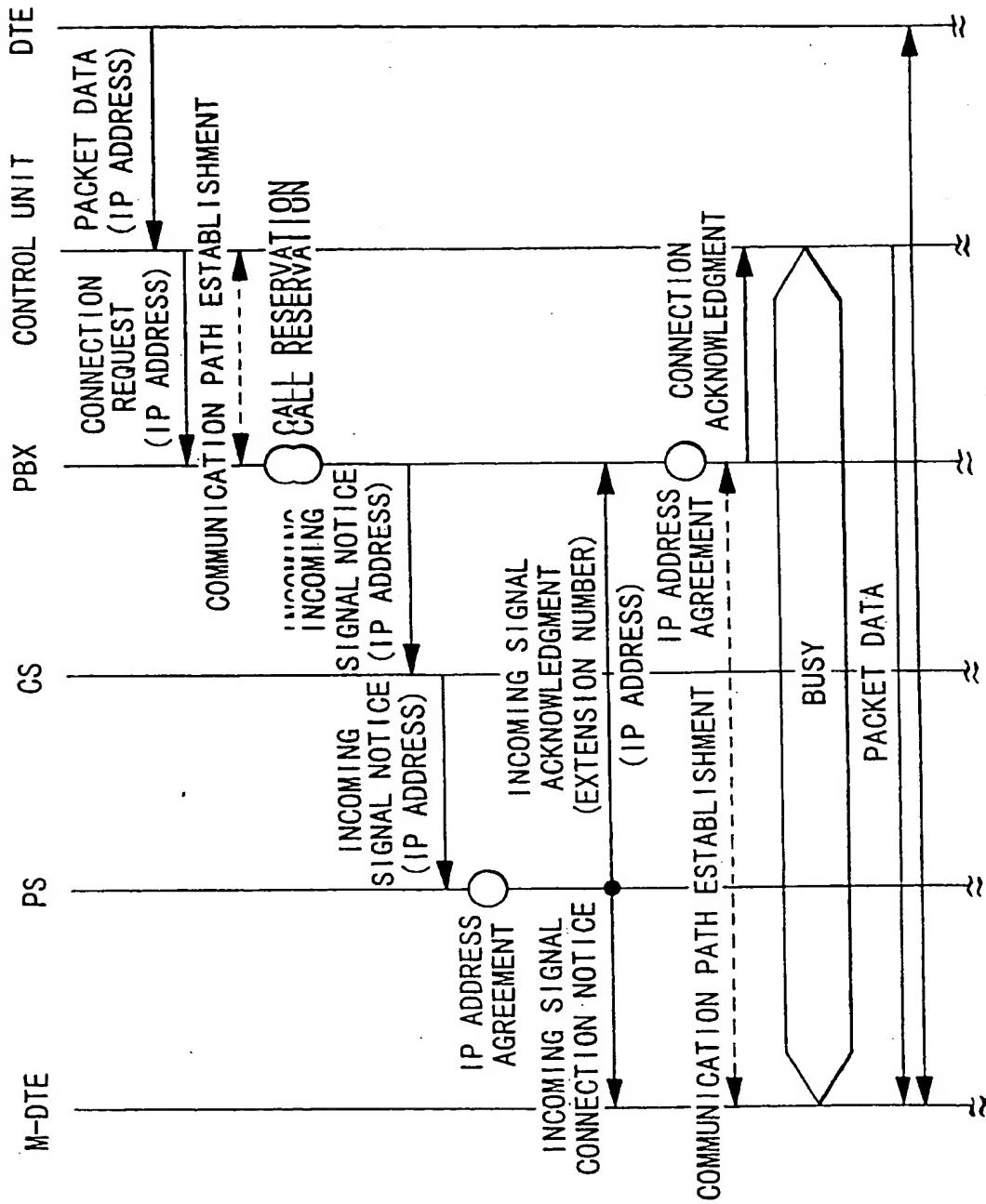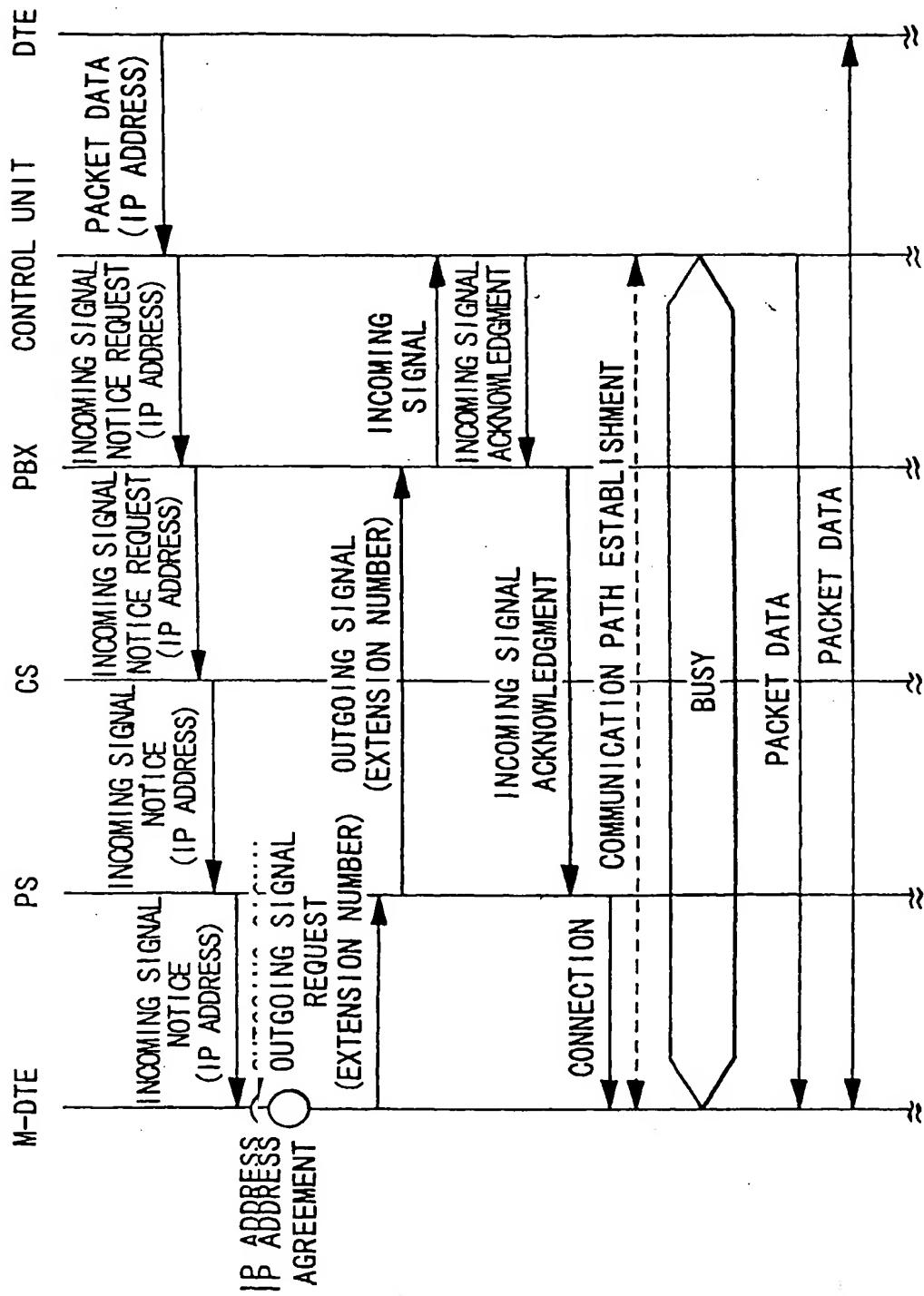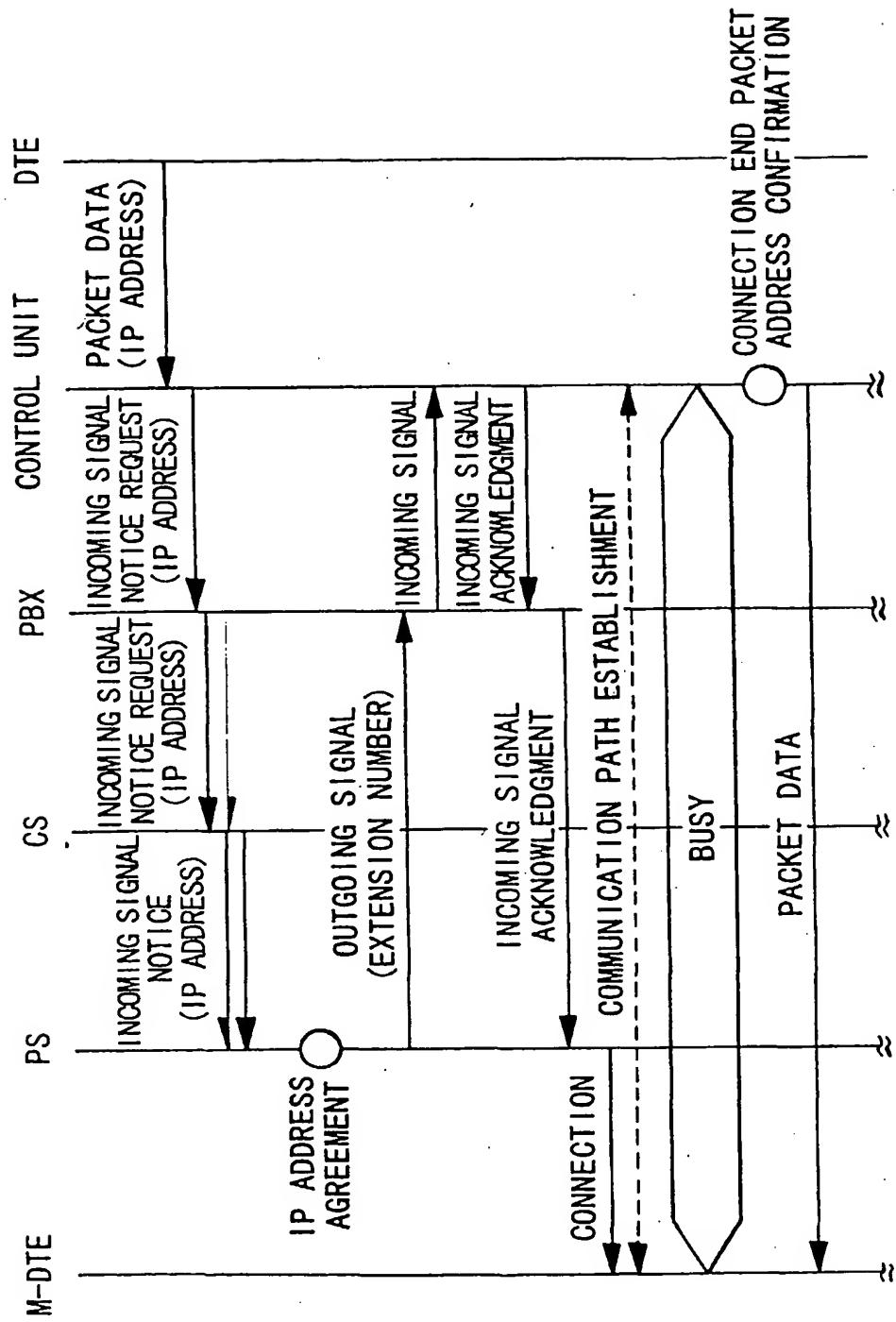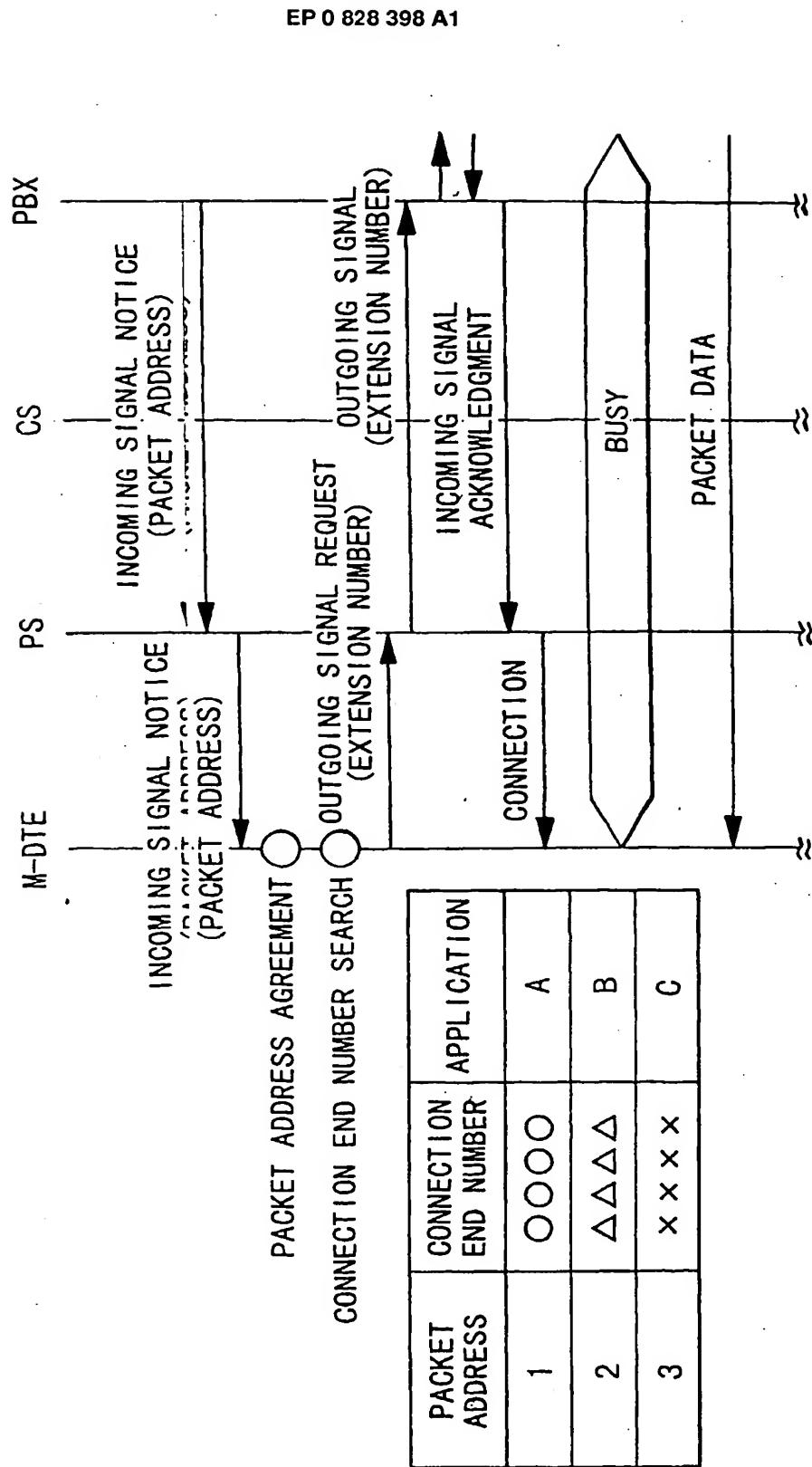
FIG. 8
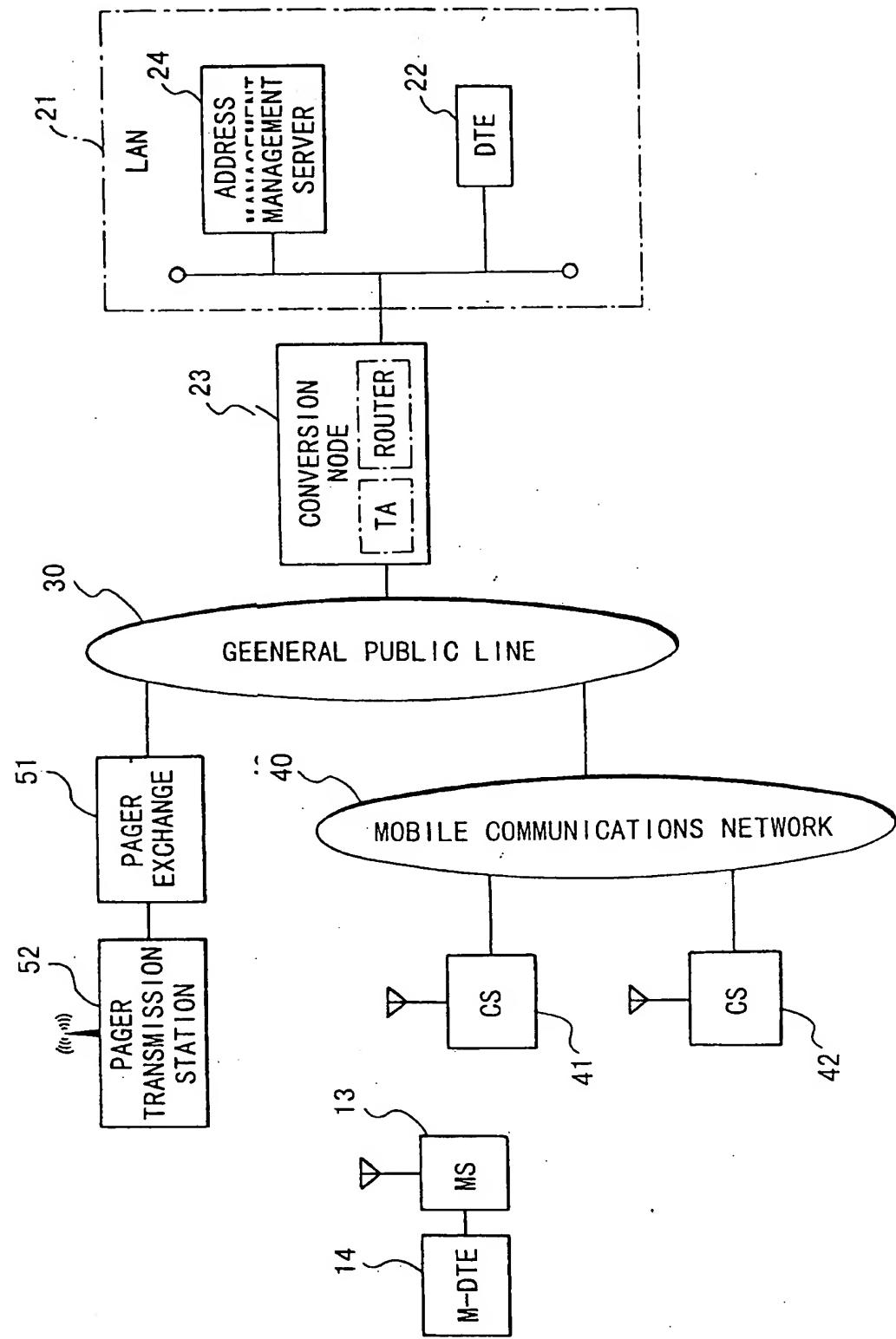
FIG. 9
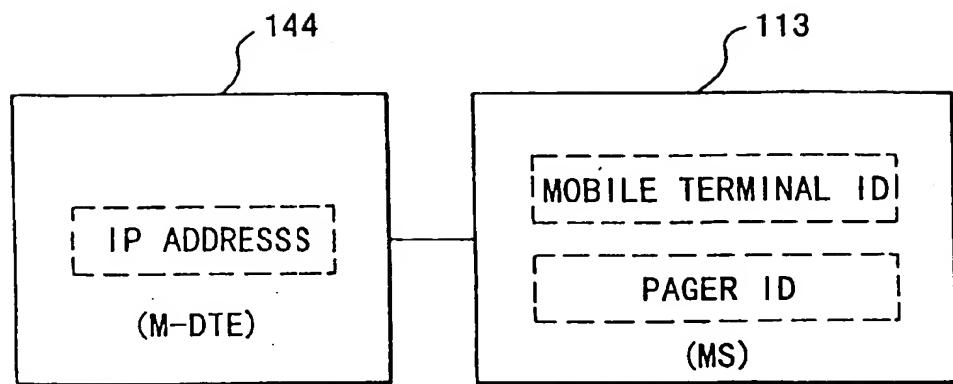
FIG. 10
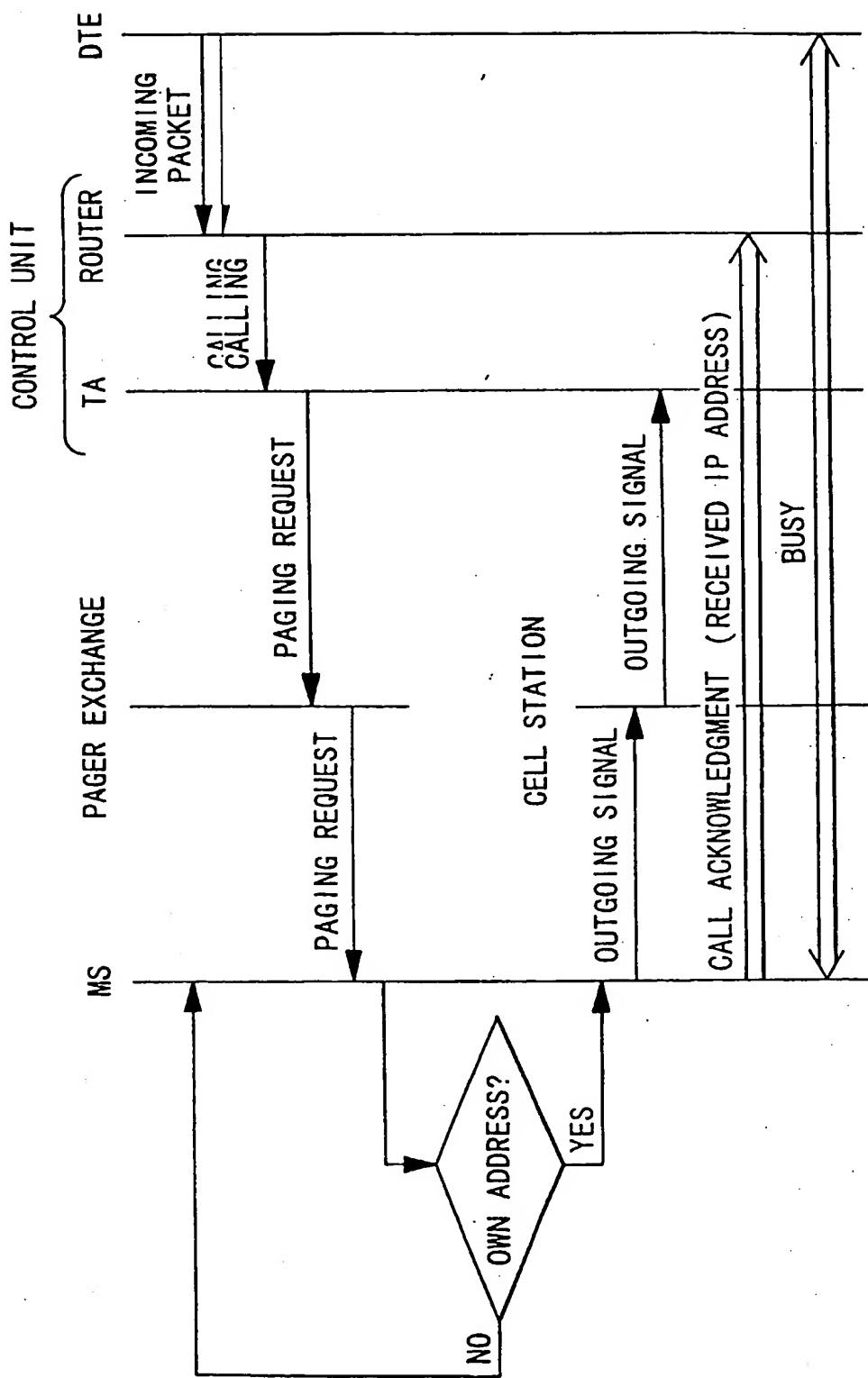
INTERNATIONAL S SEARCH REPORT

	International application No.
	PCT/JP97/00676

A. CLASSIFICATION OF SUBJECT T MATTER

Int. Cl^6 H04Q7/24, F H04L12/46

According to International Patent Classificatation (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classificatiotion system followed by classification symbols)

Int. Cl^6 H04Q7/24, F H04L12/46, H04L12/56

Documentation searched other than minimum d documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the internurnational search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO B BE RELEVANT

Category*	Citation of document, with th indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP, 7-131842, A ι (International Business Machines Corp.), May 19, 1995 (19 9. 05. 95) & EP, 647077, A ι & CA, 2133245, A & US, 5473669, A A	1 - 13
A	WO, 95/16330, A ι (Telefonaktiebolaget Ericsson L M), June 15, 1995 (1 15. 06. 95) & AU, 9512515, A A & FI, 9503775, A & EP, 683963, A ι & TW, 276382, A & JP, 8-506713, ι A & US, 5590133, A	1 - 13
A	JP, 7-221773, A (Nokia Mobil Phones Ltd.), August 18, 1995 (18. 08. 95) & EP, 663785, A	1 - 13

☐ Further documents are listed in the conontinuation of Box C.   ☐ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the internatiational search	Date of mailing of the international search report
May 21, 1997 (21. 055. 97)	June 3, 1997 (03. 06. 97)

Name and mailing address of the ISA/	Authorized officer
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